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ABSTRACT

This report describes a microcomputer system which collects data from students in classrooms on a daily basis and is then used to evaluate concept achievement and attitude changes through a time series analysis. Two pilot studies in two junior high schools in Ohio are detailed, where eighth grade students' progress in an earth science study unit on the Great Lakes was monitored using the study management program. Data from the first study were incomplete but did permit some modification of the program before it was tried again. Data for the second study show a baseline pattern of decreasing performance which has been found in other studies using this data collection system. It appears that students begin to resent having to respond to questions on information that they have not been taught; they tire of trying to answer the questions correctly; and their performance falls. However, in the "intervention" phase of data collection, when the unit is being used, the positive influence of the unit on the students' knowledge is indicated by a rising curve. It also appears that student performance remains high following the end of the unit. The text is supplemented with three figures and an eight-item bibliography is provided. (EW)

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PILOT OF A SYSTEM FOR COLLECTING DAILY CLASSROOM DATA ON LEARNING BY USING MICROCOMPUTERS

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PILOT OF A SYSTEM FOR COLLECTING DAILY CLASSROOM DATA ON LEARNING BY USING MICROCOMPUTERS

Several studies have reported on the development of the intensive time series design which allows monitoring class achievement and attitudes on a daily basis (Mayer and Monk, 1983). The system involves the administration to each student in class of a few objective items on each of the characteristics to be measured. Total administration time takes less than five minutes and typically occurs at the end of the class period. It has been used to monitor concept achievement in six studies. The results have been consistent, indicating the validity of the design by showing no effect of frequency of testing upon the data (Mayer and Rojas, 1982). The discrimination of the design has also been demonstrated; that is its ability to yield data that discriminates between the learning patterns of two different groups of children (Farnsworth and Mayer, 1984).

Each of the studies has yielded information on learning patterns consistent with current understandings of learning and some intriguing new information suggestive of some post-treatment improvement in understanding. In the Farnsworth and Mayer study, for example, achievement in understanding of plate tectonics by children operating at the formal cognitive level continued stable or accelerated several days into the post-treatment phase. This was not true of those children at the concrete cognitive level. Kwon and Mayer, 1985, reported on a method for identifying and describing what they have called the "momentum effect". The design has also produced interpretable data on attitudes.

Thus far, data have been collected through the use of paper and pencil instruments. This has been very unsatisfactory because of the time needed to assemble the instruments and to administer them, students errors in coding their response and combersome methods of handling the data. To overcome these obstacles the use of microcomputers for collecting data was investigated. This is a report of two pilots of the microcomputer system that was developed for use in collecting classroom data for this design.

Description of Microcomputer System

A system was developed which uses several microcomputers for presenting the questions and collecting the response data. It consists of two computer programs. The first is an authoring disk for preparing up to two item pools of 80 items each. The items in each pool can be categorized on two dimensions, eg., by taxonomic level of item and by instructional objective. The second disk is a study organization program. It randomly assigns items to students for each day of the study, ensuring an equal distribution of items by dimension and also ensuring that no student will get the same item more than once during the study. The results and a study management

program are then transfered by the study organization program to disks for each of the computers that will collect the data. The study mangement program will present the question, allow up to a minute for response, record the student response, and also record the amount of time taken by the student to respond.

Six to eight Commodore 64 computers, each with a disk drive and green screen monitor, were used in the two pilots. The teacher was required to boot the program disk in the morning and back up data at the end of the day on a single back-up disk. The back-up procedure automatically resets each disk for the next days questions. The two procedures take no more than 20 minutes of the teacher's time each day. When a student types in an identification code, the program presents the question(s) assigned the student for that day.

Upon completion of the study, data is transfered to a data file on the university's main computer where it is analyzed. An added feature allows the teacher to summarize the data on each computer at the end of each day. Teachers, therefore, can monitor the performance of their classes on a daily basis.

Design of Pilot Studies

The two pilots were conducted in two different junior high schools in the central Ohio region. Both were performed with eighth grade earth science classes. The studies were to run for 40 days, with 10 days as a baseline, 20 days for the intervention and 10 days as a follow-up. An earth science unit was designed focusing on the geology, limnology and weather of Lake Erie and the Great Lakes. This comprised the intervention. A pool of 80 multiple choice items were selected from those used in previous studies. In the first pilot half of the items directly related to information contained in the unit whereas the remainder were related to Great Lakes topics but not to those contained in the unit. In the second pilot all eighty items related to topics taught in the unit. A pool of attitude items using the semantic differential format were also selected from those used in previous studies. There were four concepts each with 15 adjective pairs used as distractors. The four concepts were; Lake Erie, today's science class, today I feel, and answering questions using the computer. Each student responded to one multiple choice item and one attitude item each day.

At the end of the intervention, all achievement items were administered to all students in each of the pilots to obtain information for item analysis.

Results of Pilot #1

The first pilot study was conducted with four classes totaling 80 students, all taught by the same teacher. It was expected that the performance on the unit-specific achievement items would improve following the beginning of the intervention, whereas performance on the other multiple-choice items would remain constant. It was also expected that attitudes toward Lake Erie would improve as student knowledge of the topic increased. Such changes would be consistent with other studies reported in the literature. The remaining attitude concepts were expected to vary daily in response to a variety of conditions. Unfortunately, the study could not be

completed. Because of end of year scheduling problems, it started with only about 30 days left in the school year. Several of these days were lost because of school events. Only 26 days of the study were completed. In addition, the teacher moved through the unit much more slowly than originally planned. Therefore less than one-half of the unit had been completed when school ended.

When data for the two types of multiple choice items were plotted, no trends were apparent (Figure 1). Also there were no trends for either of the four attitude concepts. Only on response time was there a significant and consistent trend. Response time dropped as the study proceeded (Figure 2).

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INSERT FIGURES 1 AND 2 HERE
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The major benefits from this pilot of the system were to debug the study management program, improve the documentation used by the teacher, modify the classroom setup and student identification procedures to decrease any problems with student use of the system, develop data analysis procedures, test the instructional unit, and obtain item analysis information on the item pools.

Results of Pilot #2

The earth science unit was used with all of the students of an earth science teacher. This included six eighth grade classes totalling 105 students. Figure three displays the data accumulated concerning student knowledge of the unit objectives as reflected by performance on the multiple-choice items taken every day over the 44 days of the study.

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INSERT FIGURE THREE HERE
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The first 11 days of the data is the baseline. The data exhibit a pattern of decreasing performance. This has been found in each of the studies using this data collection system. It appears that students begin to resent having to respond to questions on information that they have not been taught. As a result, they tire of trying to answer the questions correctly, and thus their performance falls. The positive influence of the unit on student knowledge is apparent from the gradual rise of the curve during the next phase of the data collection, the intervention phase (when the unit was being used). It is apparent that student knowledge increased gradually as the unit progressed. The highest class average was on day 36 (73.7 percent correct), the day that the unit posttest was given following the end of the unit. The mean percent correct on the unit posttest was 68.4 percent (50.4 average raw score out of 74 items; standard deviation of 9.98). It also appears that the student performance remained high following the end of the unit. This is the same pattern of performance as reported with previous studies using this design with the paper and pencil methods.

Conclusion

In previous studies the intensive time-series design had shown promise for monitoring concept growth and changes in attitudes. However the cumbersome nature of the data collecting procedures made it impractical for most classroom studies. The two pilot studies using the microcomputer based system have demonstrated its feasiblity. Using the Commodores makes it relatively cost effective. The total investment for equipment was about $6000. The first pilot demonstrated that students soon became accustomed to responding to the items as they were presented by the computer. This is indicated by the rapid decrease of response time. The first pilot also revealed bugs both in the software and hardware permitting them to be worked out. No such problems occurred during the second pilot, although one computer did cease to function and was replaced by a back-up placed at the school for that purpose. Results from the second pilot indicate that the data generated by the microcomputer system is comparable to that generated by the earlier system. Therefore it should be equally valid.

Using the microcomputer system, an intensive time-series study can be developed and administered in a short period of time assuming there exists a suitable set of multiple choice items. Using such a system it is conceivable that researchers and teachers may soon be given access to information, on a daily basis, which will indicate the growth of concept understanding and the fluctuations of attitudes within a class. For the first time it will be possible to assess the impact of teaching behavior, general classroom environment, and student characteristics of learning on a day to day basis.

Now that an efficient and easy to use data collection system has been devised researchers can design studies to examine the impact of a variety of teaching environments upon learning, not merely at single points before and after intervening but during the intervention, and on a constant basis, over whatever time interval seems appropriate to the study. Future research with this system will examine the types of variables that can be used and ways in which they can be measured. One of the next studies will focus on adapting it to collecting word association data permitting its use with concept mapping studies.

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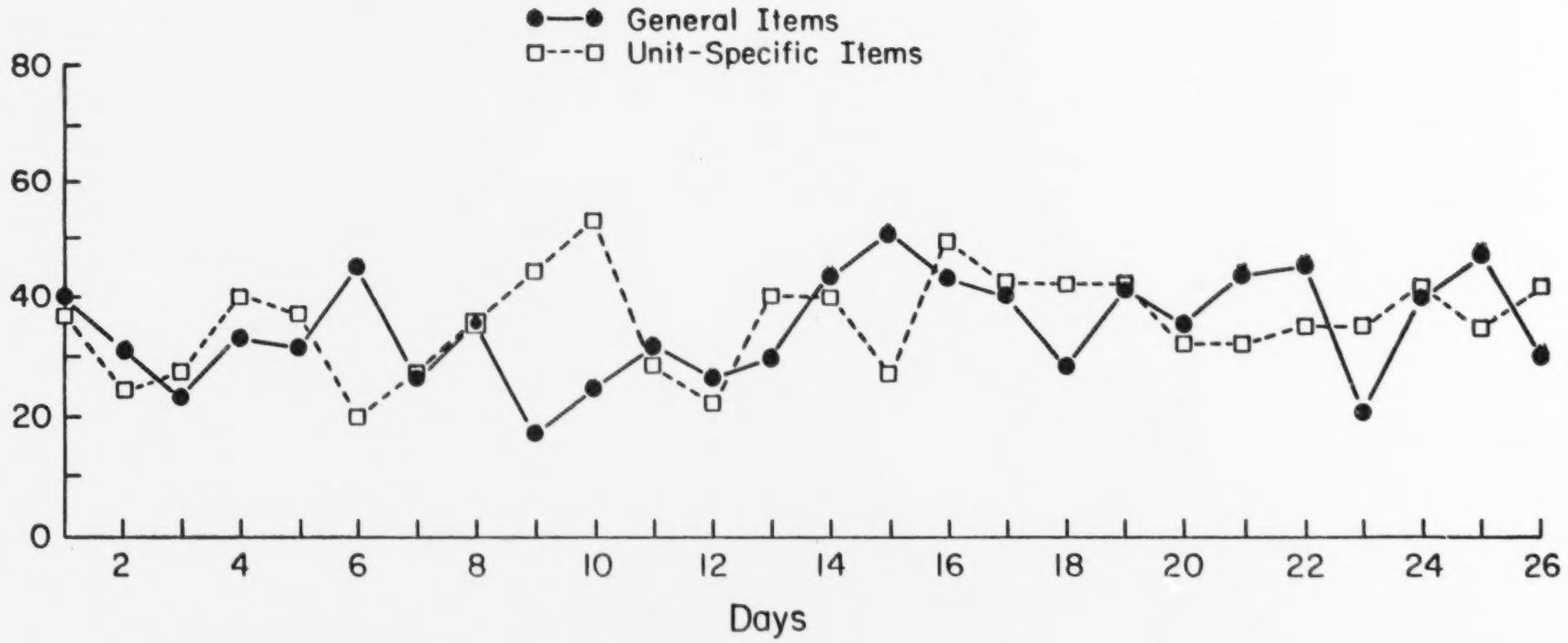

Figure 1. Changes in Knowledge

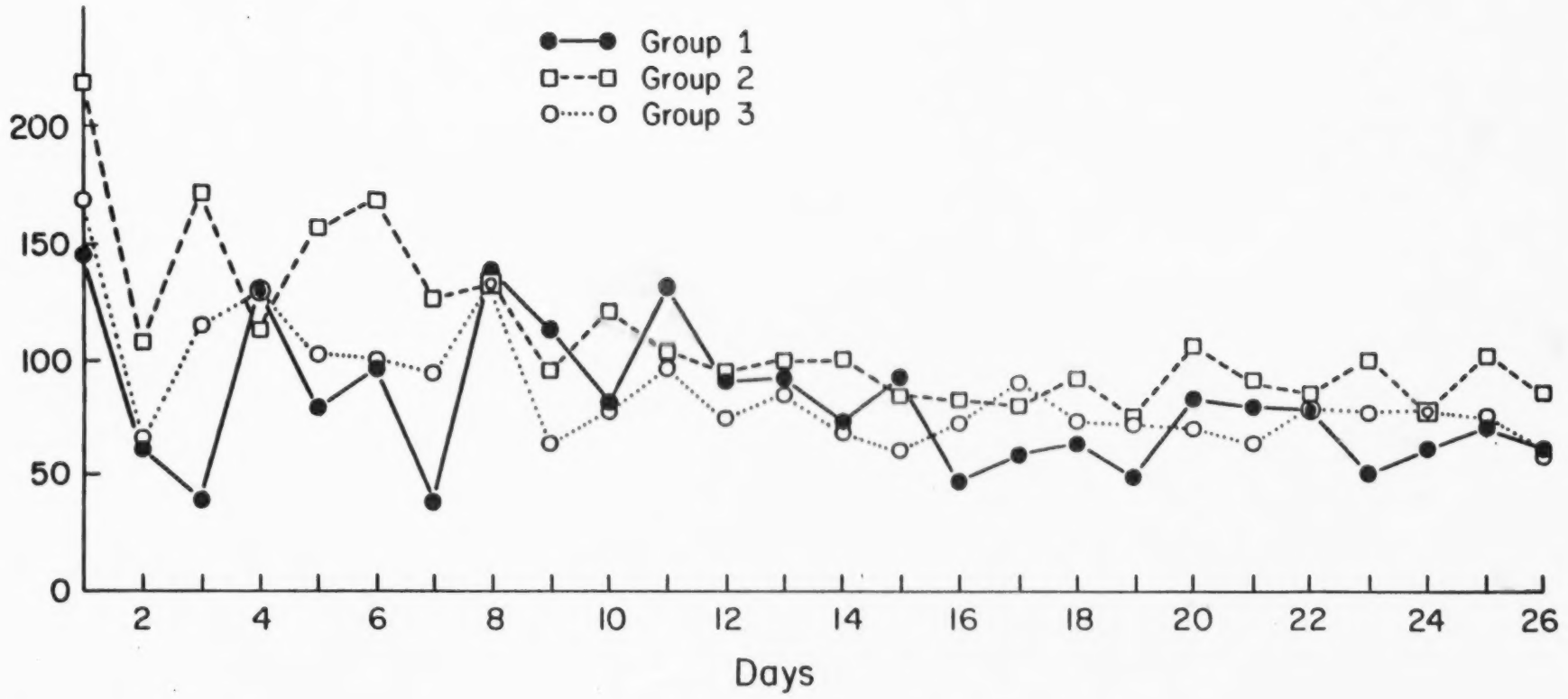

Figure 2. Response Time by Group

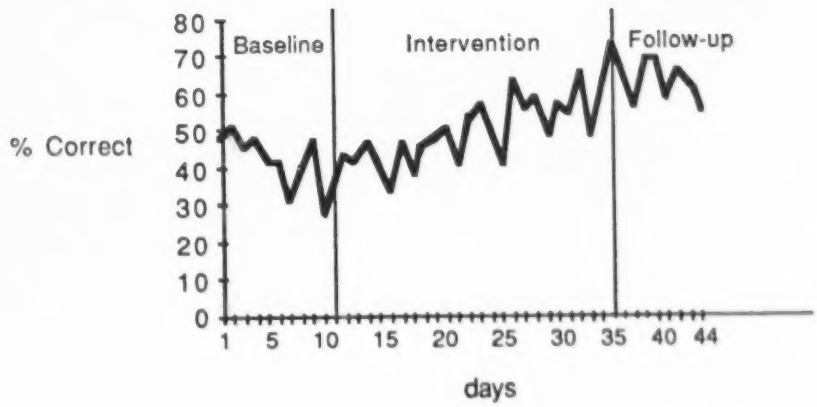

Figure 3. Trend of student knowledge during the Evaluation of the OEAGLS Unit.